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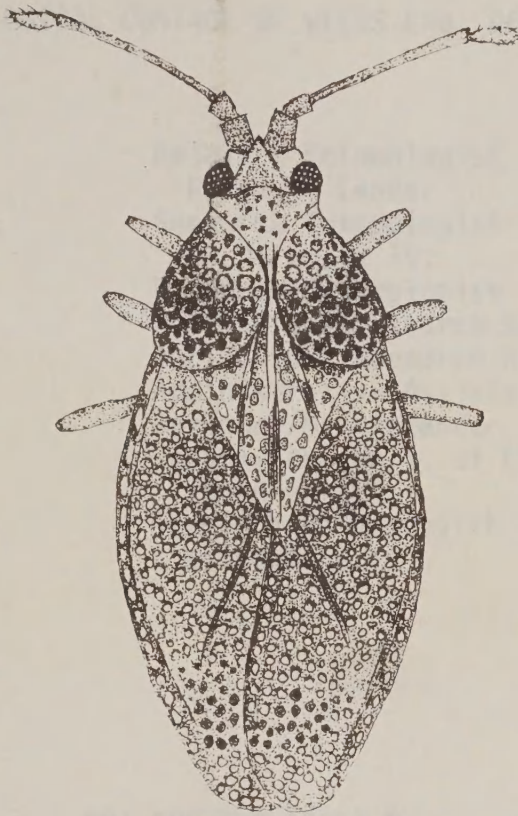
BIOLOGICAL CONTROL OF WEEDS
LABORATORY-EUROPE

1980 ANNUAL REPORT

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ANNUAL REPORT

BIOLOGICAL CONTROL OF WEEDS

LABORATORY - EUROPE

BIOLOGICAL CONTROL OF WEEDS LAB. PERSONNEL

| | |
|--------------------|---|
| Neal R. Spencer | Research Entomologist - Location Leader - Research Leader |
| Paul E. Boldt | Research Entomologist - returned to the States on December 15. |
| Antonio Rizza | Research Entomologist |
| Pasquale Pecora | Agriculture Research Assistant |
| Gaetano Campobasso | Agriculture Research Assistant |
| Donatella Magni | Administrative Assistant |
| Antonio Laregina | Gardener/Maintenance |
| Niklaus Hostettler | Technician (Univ. of Calif. cooperative agreement). |
| Rouhollah Sobhian | Research Entomologist (Univ. of Calif. cooperative agreement). |

NOT FOR PUBLICATION

NOTICE

The results of this report are preliminary and should not be quoted or discussed in publications without permission of the responsible scientist. If there is need to refer to this work, please correspond with the scientist and include a copy of the pertinent portion of your manuscript. The work should be cited as a personal communication and not in the bibliography. This report has an extremely limited distribution and is intended only to provide a mean of communication among scientists and to provide a historical record of our laboratory.

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INTRODUCTION

The following report is our best effort to provide the interested reader with a condensed report on the activities of the Biological Control of Weeds Laboratory-Europe. A criticism of our 1979 Annual report was that it was too long and too detailed for an annual report. These annual reports provide an opportunity for the laboratory staff to condense and analyze the data gathered during the course of the previous year's research. It is also a time when the research for the coming season's work is planned, using the previous year(s) as the base on which to build.

In Rome the winter season tends to be cool and wet and most of the research programs are inactive because of dormancy of the weeds and their control agents. It is during this period that data is tabulated, analyzed and prepared for reports and publications. As these procedures are completed, a consensus is reached with the Research Leader on the research program for the following year. These program lines are reviewed with the Technical Advisor for the USDA-SEA-AR Biological Control of Weeds Research program and with other researchers interested in weeds that have been targeted for research by the Rome Laboratory.

The research program of the Laboratory continues to develop and the output of the Laboratory in terms of research and shipments of biotic agents is a credit to the Lab staff. The contract with Dr. G. Defago of the Institute für Phytomedizin, Zurich, Switzerland has added to our capabilities in biological weed control research. We are now able, through this research contract, to work on plant pathogens that may have weed control potential.

In 1981 Dr. Rouhollah Sobhian, working for the laboratory under a University of California cooperative agreement will establish a substation in Thessaloniki, Greece for a concentrated study on yellow star thistle, *Centaurea solstitialis*. The research planned for this important weed in 1981 will provide the foundation for a decision on the future direction research should proceed toward the development of an economic, environmentally safe and effective control for YST.

Mr. Paul Boldt left the Rome Laboratory in December after almost seven years in Italy. By the end of the tour the family called Rome Home and to all of the family: Paul, Chris, Randal and Jeff, Italian sounded like English. Paul is now stationed in Temple, Texas, working with Dr. C.J. Deloach on weeds of our southwestern rangeland.

Mr. Paul H. Dunn who was in Rome from December 1966 to July 1973 will return to the Rome Lab in the early spring of 1981 as the replacement for Mr. Boldt. Mr. Dunn will be returning to Italy with an excellent command of Italian and a knowledge of Europe and the Middle East.



Neal R. Spencer
Research & Location Leader

April 1981.

LINARIA DALMATICA PROJECT

A. Rizza and P. Pecora

The dalmatian toadflax project was resumed and reassigned to the Rome lab. in 1977 by Dr. L.A. Andres. The four insect species listed below have been tested (See 1977-78-79 Annual Reports) as possible biocontrol agents of *L. dalmatica*.

1) *Chrysomela rossia* (Col. Chrysomelidae)

Tests completed and results published in 1980 (Ann.Ent.Soc.of Am. 73(1):95-99). The insect was found non-specific and consequently dropped from further consideration.

2) *Chrysomela gypsophylae* (Col. Chrysomelidae)

Tests have been completed and results readied for publication. The insect's host range was found to be restricted to the tribe Antirrhineae, of which *Linaria* is a member. The tribe Antirrhineae include ornamental species, the most important of which is snapdragon, *Antirrhinum majus*. No records were found of the insect attacking *Antirrhinum* in the european literature.

3) *Eteobalea (Stagmatophora)*spp. (Lep. Cosmopterigidae).

The earlier research conducted under a Yugoslavian PL 480 project on *Eteobalea serratella* indicated that this species might be a suitable biocontrol agent if additional tests showed a more restricted host range. During our screening program with *Eteobalea*, two types of eggs were noticed; one type with a reticulated chorion and one with a striated chorion. These egg types were produced by insects ex. *Linaria dalmatica* and ex. *L. vulgaris*. We thus realized that we were probably working with more than one *Eteobalea* species. To confirm our suppositions, specimens from *L. dalmatica*, *L. vulgaris* and wild *Antirrhinum majus* were shipped to Dr. T. Riedl, a Polish Cosmopterigid specialist. Dr. Riedl's determinations showed that *Eteobalea serratella* (egg striate) and *Eteobalea intermediella* (egg reticulate) were both present on *L. dalmatica* and *L. vulgaris*. A third species, *Eteobalea beata* was found only on wild *Antirrhinum*.

Della Beffa (Gli Insetti dannosi all'Agricoltura) for Italy, and Balakowski (Entomologie appliquee a l'Agriculture) for France do not list any Cosmopterigidae of the genus *Eteobalea* as a pest on *Antirrhinum* or other cultivated plants. Field and laboratory larval survival tests were made on 1979 with *Eteobalea intermediella* ex *Linaria dalmatica* (from Bitola, Yugoslavia) and *Eteobalea serratella* and *L. vulgaris* (from Rome, Italy) (see 1979 Annual Report).

The results were homogeneous for both laboratory and field experiments. *Antirrhinum* was accepted as an alternate host by both *Eteobalea* species. It was found also that the *E. serratella* (ex. *L. vulgaris*) did not accept the US dalmatian toadflax as no larval survival occurred in both the greenhouse and the field experiments. This fact eliminated any further consideration of this strain for the biocontrol of *L. dalmatica*. The *Eteobalea intermediella* ex. *L. dalmatica*, instead, can be considered as a potential biocontrol agent for dalmatian toadflax in the US. However, its use, is related to the economic importance of *Antirrhinum* in the area of the US where *Linaria* is found.

In 1980, a larval survival test was planned to complete the screening of the remaining strains: *Eteobalea serratella* ex. *L. dalmatica* and *Eteobalea intermediella* ex. *L. vulgaris*. Infested roots of both plant species have been collected and

maintained in the laboratory for adults eclosion. Unfortunately because of a lack of a qualified technician, the test was not completed during a period when the authors were both on field surveys.

We believe that both *Eteobalea intermediella* (*L. dalmatica* strain) and *Chrysomela gypsophilae* should be considered as potential biocontrol agent for dalmatian toadflax into the US.

However, until cost-benefit data on *Antirrhinum* in relation to the economic impact of dalmatian toadflax are developed the project will remain in limbo; Maiores premunt.

Collections

Eteobalea (*Stigmatophora*) spp. (Lep. Cosmopterigidae) - Pecora, Campobasso.

Two groups of 500 roots of *Linaria dalmatica*, containing larvae of *Eteobalea* spp. were collected at Bitola (Yugoslavia) and at Prespa lake (Greece) on June 1 and June 14 respectively. All this material was sent to the Rome lab., to complete the host specificity studies on *E. serratella* and *E. intermediella*.

Plant *antirrhinum* in *Linaria* patches and
check after 2 years to see % infestation

EUPHORBIA PROJECT

A. Rizza and P. Pecora

The first step of the project has been completed with the survey trips for plants, insects and pathogens made during the past years in the Balkans and central Europe. Live plants, herbarium collections and a list of insects collected on various *Euphorbia* spp. are available. The pathogens collected in various countries and at various times of the year are now being sorted and studied in Zurich, Switzerland (USDA-SEA-AR, sponsored research program).

Dr. Giuliano Cesca, a Professor of the University of Calabria, is conducting a cytological study of US and european *esula-virgata* group. He has also identified all the *Euphorbia* spp. collected during our survey trips. Dr. Cesca's work is not contracted.

Representative herbarium samples available in the Rome lab will also be sent to Dr. Alan Radcliffe-Smith, an English specialist. Thus, we hope to better comprehend the taxonomic position of the US leafy spurge in relation with the european species given the same name.

To avoid unnecessary and expensive duplication of effort between the USDA and the CIBC labs, the following insects were selected as potential candidates for a biocontrol program for the Rome lab.: *Oncochila simplex* (Hem; Tingidae); *Bayeria capitigena*, and *Dasyneura capsulae* (Dipt: Cecidomyidae); *Symira dentinosa* (Lep: Noctuidae); *Neoplinthus tigratus* (Col: Curculionidae); and an unidentified Tephritidae (Diptera).

Oncochila simplex

The screening of this oligophagous insect has been completed this year (see 1979 Annual Report) and a manuscript is being prepared on the biology and host specificity of this Tingid. The insect is now in the USDA-SEA-AR quarantine facility, Albany, California undergoing additional tests with domestic endangered and economic *Euphorbia* species. Our tests showed that *O. simplex* is a good potential biocontrol agent because:

- a) Negative host records on economic plants in Europe.
- b) Our tests showed the host range restricted to the genus *Euphorbia* (intraspecific).
- c) *O. simplex* is well synchronized with the phenology of its host.
- d) The insect causes severe plant decline when it occurs on *E. esula* in large numbers. (see photos)
- e) It has a high reproductive potential.
- f) Multivoltine.

Negative factors to be considered are:

- a) The insect is brachypterous in both sexes.
- b) *Euphorbia lathyris* was found to be a suitable laboratory host.
This plant is being considered as a source of energy because of its high hydrocarbon content.

A low dispersion rate caused by the insect's inability to fly would be minimized by the insect's high reproductive potential and by the ease with which the Tingid can be cultured in the lab. The ability of *O. simplex* to live on *E. lathyris* is of some concern, even though our limited field tests showed a tendency of the

insect to leave *E. lathyris* under field conditions.

The results of the settlement of this conflict will effect not only *O. simplex* but any future research on potential biocontrol agents for leafy spurge. It is important to answer these conflicts as they arise since they will effect future programs.

B. capitigena and *D. capsulae*

A collection of *E. esula* tips infested by galls of *D. capsulae* was made in S. Rossore (Pisa) on June 1980. Unfortunately, for lack of qualified help (we were both out of the lab in different trips), we were unable to start a colony. This year emphasis will be put on both insects. We hope to collect enough material in Italy and the Balkans to start a testing program.

Symira dentinosa

The 350 pupae collected in Greece on May 1979, were maintained at the Rome lab under different conditions. Only 27 adults emerged in the spring 1980 although the pupae were well formed and the few dead ones were not diseased. The paired adults failed to lay fertile eggs. If time and personnel are available, a collection of eggs will be made in Greece in late March or early April, 1981. This, we hope, will provide a start on host specificity testing and will increase our knowledge on the bionomics of the species.

Neoplinthus tigratus

Twenty roots of *E. esula* containing mature larvae and pupae of *N. tigratus* were collected at S. Rossore (Pisa) in October, 1979. From these roots only three adults emerged at the end of April 1980. The fresh adults were first caged with *E. esula* plants, but no feeding occurred. No feeding also when were caged with *Humulus lupulus* and *Rumex crispus* the only two recorded hosts of other *Neoplinthus* species. All the three insects died after two months without feeding.

We believe that *N. tigratus* may have one or more alternate host(s) during the adult stage. Because the insect is apterous, the alternate host(s) should be in the vicinity of the larval stage host (*E. esula*). We hope to determine the adult biology in 1981.

An insect with such strange behaviour may not be worthwhile for future BC work, nevertheless, the damage on *E. esula* roots is so drastic as to justify our interest.

Tephritidae

A probable infestation of this insect was noticed at Bosco Mesola (Ravenna, Italy) at the beginning of the past July. Young *E. cyparissias* plants were found dead. We believe that the damage found here was the same as found in Bulgaria on *E. cyparissias* in 1978. A trip will be made to Bosco Mesola at the end of March or early April, 1981 to verify the infestation.

Work Plan for 1981

Pathogens

Collect material in Italy and elsewhere and send to Dr. Defago, Switzerland.

Oncochila simplex

The screening of this insect has been completed. However, the conflict with

E. lathyris (already mentioned) suggests additional testings. A series of field tests will be made to ascertain the impact of this tinging on *E. lathyris* under field conditions. Contacts with Botanical Institutes of various Italian universities are already taken in order to obtain data on eventual occurrence of *E. lathyris* in Italy. An active colony is maintained in the lab to furnish the necessary *O. simplex* adults for our field tests.

B. capitigena and *D. capsulae*

Collect material in Italy and the Balkans and start lab colonies on US plants. If promising, start screening.

Symira dentinosa

If time and personnel available, collection of eggs will be made in northern Greece in early April. Try US plants and start a lab colony.

Neoplinthus tigratus

A little time will be spent to better comprehend the behaviour of this beetle.

Tephritidae

In connection with other trips a visit will be made to Bosco Mesola (Ravenna) at the end of March, early April 1981 to determine the organism causing the *E. cyparissias* root damage.

Trips

- 1) A trip in June to the Balkans for the collection of pathogens and cecidomyde.
- 2) Survey trips in Italy to find new *Euphorbia esula* locations with *Oberea erythrocephala* and Cecidomyidae spp.
- 3) Various trips to Piacenza and S. Rossore (Pisa) for *O. simplex* field tests.

Collections

Over 100 pairs of *Oberea erythrocephala* are requested by Albany lab for release into the US.

PHYTOPHAGOUS INSECTS OF LYTHRUM SALICARIA IN ITALY.

PAUL E. BOLDT

A general survey of Italy, including Sardegna and Sicilia, was made from September through November 1980. At each collecting site, plants were examined closely for insect injury and damage. Insects were hand picked, aspirated or dissected from 5 to 25 plants. Additional plants were often transported to the Rome laboratory for a detailed search for endophagous insects. Immature insects that were collected, were reared to maturity on excised plant material when possible and adults found resting on the plant were caged on leaf bouquets to confirm their ability to feed. In addition, at least 25 mature flower spikes and stems were collected in bulk monthly from near Rome and held for up to one month or to death of the plant for emergence of insects. Plants closely associated with *L. salicaria* were collected when possible and were identified with the assistance of Prof. Dr. Carlo H. Steinberg, Director, Herbarium Universitatis Florentine, Firenze.

Results

L. salicaria was found throughout Italy including the islands, Sardegna and Sicilia (Fig. 1). It was usually present as single plants or scattered clumps of plants. High densities of plants covering large areas were not observed. Plants were most common in fresh water moist areas that were adjacent to lakes, streams or dams, or along the banks of slow moving drainage ditches.

The plant was the host or alternate host for 52 species of insects representing 17 families and 6 orders (Table 1). Insects that fed exclusively on pollen were excluded from this list. The majority (71%) of these insects fed, at least in part, on the leaves although all major plant parts: root, stems, leaves, and flowers, were infested to varying degrees.

In assessing the value of the insects as potential biological control agents only those 11 species recorded in the literature as feeding only on *L. salicaria* and the 7 species recorded as feeding on plants in the same genus were considered. Those insects which appeared worthy of further study are:

Hylobius transversavittatus (Curculionidae)-- The larvae caused heavy damage to roots and were present in a large proportion of the inspected plants from Toscana and Piemonte. It was recorded as having 1 generation/yr and adults were nocturnal.

Haltica impressicollis (Chrysomelidae)--Adults were both abundant and destructive of the foliage in almost all of Italy. As many as 200 beetles were occasionally collected from a single plant. Although recorded from Poland and the USSR, it is generally regarded as a Mediterranean species.

Haltica lythi (Chrysomelidae)--Adults were recorded as common in central and northern Europe. It was very closely related to *H. ampelophaga*, a pest of vineyards. The literature was confused and several authors treated *H. lythi* and *H. ampelophaga* as subspecies.

Pyrrhalta calvariensis (Chrysomelidae)--Recorded as common in Toscana. It may have already been accidentally introduced in the United States. There are three to four generations/yr.

Aphthona lutescens and *Lythreria salicaria* (Chrysomelidae)--Regarded as common and destructive leaf feeders (Bindi and Daccordi, personal communications). They probably were most common in the spring as only a few specimens of each were collected in this survey.

Nanophyes marmoratus (Curculionidae), *Syntarucus perithous* (Lycaenidae), and *Eupithecia* spp. (Geometridae)--Occurred at practically all sites throughout Italy. Often 80% of the flower parts on 1 spike were damaged or destroyed. Further observations are necessary to determine the amount of damage caused by each species before any can be selected for study as a biological control agent.

The remaining insects were eliminated from consideration because they were known to be polyphagous, were not sufficiently destructive, or were not identified to species.

Some fall flowering plants associated with *L. salicaria* at the collection sites are listed in Table 2. The most commonly observed plants were: *Arundo donax*, *Epilabium hirsutum*, *Mentha aquatica*, *Convolvulus sepium*, and *Typha* sp.



Table 1. Phytophagous insects on *Lythrum salicaria* L. in Europe. 1980.

| Insects | Associated Plant Parts | Host Specificity | Biological Control Potential | Source |
|---|------------------------|------------------|------------------------------|--------------|
| Homoptera | | | | |
| Aphidae | | | | |
| <i>Aphis gossypii</i> Glover | L | - | | personal |
| <i>Aphis fabae</i> Scop. | L | * | | Buhr 1964 |
| <i>Aphis salicariae</i> Koch | L | *** | | Patch 1938 |
| <i>Myzus lythri</i> (Schrank) | L | *** | | personal |
| Cicadellidae | | | | |
| <i>Empoasca</i> sp. | L | * | | personal |
| <i>Cicadella viridlis</i> (L.) | L | * | | personal |
| Cercopidae | | | | |
| <i>Philaenus spumarius</i> (L.) | L, F, S | * | | personal |
| <i>Cercopis sanguinolenta</i> (Scopoli) | L, F, S | * | | personal |
| Tettigometridae | | | | |
| <i>Tettigometra</i> sp. | L | * | | personal |
| Coccidae | | | | |
| <i>Ceroplastes sinensis</i> Del Guercio | L | - | | personal |
| Pseudococcidae | | | | |
| <i>Pseudococcus obscurus</i> Essig | L | - | | personal |
| Hemiptera | | | | |
| Miridae | | | | |
| <i>Lygus</i> sp. | L, F | | | personal |
| <i>Adelphecaris lineolatus</i> (Goeze) | L, F | * | | personal |
| Pentatomidae | | | | |
| <i>Hezara viridula</i> (L.) | L | * | | personal |
| <i>Eysarcoris</i> prob. | L | - | | personal |
| <i>Graphosoma italica</i> (Mueller) | L | - | | personal |
| <i>Holcostethus</i> sp. | L | - | | personal |
| Lygaeidae | | | | |
| <i>Nysius</i> prob. <i>ericae</i> Schilling | L, F | | | personal |
| Thysanaptera | | | | |
| unidentified sp. | L, F, S | - | | personal |
| Lepidoptera | | | | |
| Family unknown | | | | |
| <i>Apoderus erythropterus</i> Zschach. | L | * | | Hoffman 1954 |
| <i>Apterona paludella</i> Dannehl | L | - | | Hering 1957 |
| <i>Coleophora paripennella</i> Z. | L | - | | Hering 1957 |
| <i>Euspilapteryx phasianipennella</i> Hb. | L | * | | Hering 1957 |
| <i>Monochroa (Xystophora) morosa</i> Muhl. | L | - | | Hering 1957 |
| Geometridae | | | | |
| <i>Chloroclystis v-ata</i> Hw. | L | * | | Hakan |
| <i>Eupithecia</i> spp. | F | - | yes | personal |
| Lycaenidae | | | | |
| prob. <i>Syntarucus pirithous</i> (L.) | F | - | yes | personal |
| Coleoptera | | | | |
| Chrysomelidae | | | | |
| <i>Aphthona lutescens</i> (Gyll.) | L | *** | yes | personal |
| <i>Chrysolina fastuola</i> L. | L | * | | personal |

| | | | | |
|---|------|-----|-----|---------------------|
| <i>C. menthastri</i> Saff. | L | * | | personal |
| <i>Pyrrhalta</i> (<i>Galerucella</i>) <i>calamrienis</i> L. | L | ** | yes | Zacchi 1953 |
| <i>P. pusilla</i> Dftschm. | L | - | | Hering 1957 |
| <i>Haltica ampelophaga</i> (Guerin) | L | * | | personal |
| <i>H. impressicollis</i> Reiche | L | *** | | personal |
| <i>H. lythri</i> Aube | L | *** | yes | personal |
| <i>H. oleracea</i> (L.) | L | * | | personal |
| <i>Lythrraria salicaria</i> Pay K. | L | *** | yes | personal |
| <i>Psylliodes picina</i> | L | * | | Balachowsky 1963 |
| Curculionidae | | | | |
| <i>Anthonomus rubi</i> (Herbst) | L, F | * | | personal |
| <i>Hylobius transversovittatus</i> (Goeze) | R | *** | yes | personal |
| <i>Lixus irridis</i> Ol. | S | * | | personal |
| <i>Nanophyes annulatus</i> Arag. | L | ** | | Hoffman 1958 |
| <i>N. brevis</i> Boh. | F | *** | ? | Hoffman 1958 |
| <i>N. circumscriptus</i> Aube | S | *** | yes | Hoffman 1958 |
| <i>N. globifrons</i> Kiesenev. | S | ** | ? | Hoffman 1958 |
| <i>N. hemisphaericus</i> Olivier | S | ** | ? | Hoffman 1958 |
| <i>N. marmoratus</i> (Goeze) | F | ** | yes | personal |
| <i>N. nitidulus</i> | S | ** | ? | Hoffman 1958 |
| <i>N. yvonnae</i> | | *** | ? | Hoffman 1958 |
| <i>Phytobius comari</i> Herbst | L | * | | Hoffman 1954 |
| Mordellidae | | | | |
| Unidentified sp. | | - | | personal |
| Diptera | | | | |
| Cecidomyiidae | | | | |
| <i>Aphidoletes aphidimyza</i> (Rondani) | | - | | personal |
| <i>Dasyneura</i> (<i>Dasineura</i> ?) <i>salicariae</i> | | *** | ? | Hedicke 1938 |

L = leaf, S = stem, R = root, F = flowers

*** = probably restricted to *Lythrum* spp.

** = probably restricted to Lythraceae

* = occurs on host plants in other plant families

- = unknown

personal = personal record of author

Table 2. Plants collected and associated with *Lythrum salicaria* L.
in Italy, 1980.

| Name | Family | Location |
|--|------------------|--------------------------|
| <i>Eupatorium cannabinum</i> L. | Compositae | Sesto Calende, Lombardia |
| <i>Linaria vulgaris</i> L. | Scrophulariaceae | Passignano, Umbria |
| <i>Odontites serotina</i> Du. | Scrophulariaceae | Borghetto, Umbria |
| <i>Epilobium hirsium</i> L. | Onagraceae | Rosarno, Calabria |
| <i>Epilobium hirsium</i> L. | Onagraceae | Passignano, Umbria |
| <i>Artemisia verlotorum</i> Lamte. | Compositae | Passignano, Umbria |
| <i>Helmintha echinoides</i> Gherin. | Compositae | Lentini, Sicilia |
| <i>Mentha aquatica</i> L. | Labiatae | Lentini, Sicilia |
| <i>Mentha aquatica</i> L. | Labiatae | Monastir, Sardegna |
| <i>Policaria vulgaris</i> Gherin. | Labiatae | Cuneo, Piemonte |
| <i>Chenopodium orbicum</i> L. | Chenopodiaceae | Cuneo, Piemonte |
| <i>Polygonum lapathifolium</i> L. | Polygonaceae | Cuneo, Piemonte |
| <i>Galium rotundifolium</i> L. | Rubiaceae | Cuneo, Piemonte |
| <i>Polygonum minus</i> Huds. | Polygonaceae | Viverone, Piemonte |
| <i>Verbena officinalis</i> L. | Verbenaceae | Viverone, Piemonte |
| <i>Linum</i> sp. | Linaceae | Sesto Calende, Lombardia |
| <i>Arundo paragmites</i> L. | Poaceae | Sesto Calende, Lombardia |
| <i>Arundo paragmites</i> L. | Poaceae | Mesola, Veneto |
| <i>Convolvulus sepium</i> L. | Convolvulaceae | Mesola, Veneto |
| <i>Cyperus</i> confr. <i>flavescens</i> L. | Cyperaceae | Olbia, Sardegna |
| <i>Agrotis</i> sp. | Poaceae | Sperlonga, Lazio |
| <i>Molinia caerulea</i> Munch. | Poaceae | Mesola, Veneto |
| <i>Typha</i> sp. | Typhaceae | Latina, Lazio |
| <i>Typha</i> sp. | Typhaceae | Borghetto, Umbria |

CENTAUREA DIFFUSA

G. Campobasso - N. Spencer

WORK PROGRAM

Survey trip: Field observations and collections were made in Greece for the second year, revisiting the known locations for *Centaurea diffusa*. As we observed last year (1979) and ascertained this year (1980), *C. diffusa* is common in open areas and disturbed sites along roads in Northern Greece. Generally *C. diffusa* was found to occur on sandy and/or gravel (stony) soils. The most common plants found associated with *C. diffusa* were: *Sonchus* sp., *Onopordum* sp., *Carthamus lanatus*, *Cirsium* spp., and *Carduus* sp. Five hundred and twenty eight roots of *C. diffusa* were collected in the vicinity of Kavala and transported to the Rome Lab, during the latter part of June. Emergence of *Sphenoptera jugoslavica* adults was observed during this period. Not a single adult of *Pterolonche inspersa* emerged. The material was transplanted into flower pots using sandy river soil in the Rome laboratory. These pots containing the infested roots were placed in wooden cages (90 x 90 x 90 cm) and watered periodically. Also, periodically from June through July *C. diffusa* roots were dissected to follow *P. inspersa* larval development and to recover *S. jugoslavica* for shipping in Albany, Ca.

Pterolonche inspersa Stgr. (Lepidoptera-Pterolonchidae)

Our specimens were identified by Dr. H.J. Hannemann, Zoologisches Museum Humboldt, Universitat Berlin. Dr. Gozmany, Hungarian Natural History Museum, Budapest, in a personal communication stated that little is known about biology of the genus *Pterolonche*. Some species have been collected from grasslands and it was presumed that the larvae fed upon grass roots, however no *Pterolonche* larvae had previously been associated with a plant species before the biocontrol effort on *C. diffusa* began.

Geographic Distribution.

During the survey trips (1979-1980) in Yugoslavia, Bulgaria, and Greece we found *P. inspersa* only in northern Greece. Between 1961 to 1973, Dr. H. Zwölfer found *P. inspersa* only in northern Greece and western Turkey (unpublished data) after searching in southern France, the Swiss Rhone valley, eastern France, south western Germany, Yugoslavia, Greece, Turkey, Bulgaria, Romania and the southern part of USSR.

Host plants.

There are no published host records for *P. inspersa*. In northern Greece we found the species in roots of *C. diffusa*. During the survey made by Dr. Zwölfer (1963-71) *P. inspersa* larvae were found in roots of *C. maculosa*, *C. paniculata*, and *C. diffusa* (unpublished data). Wherever we collected *P. inspersa* larvae, we also dissected *Onopordum* sp., *Cirsium* spp., *Sonchus* spp., and *Carduus* sp. No larvae were found in any of these closely related plant species.

Biology notes.

All biological data were developed from tests conducted in the laboratory under natural daylength during July and August. The larva of *P. inspersa* can be found in *Centaurea diffusa* roots in two different places: in the root core and

under the epidermis in tunnel 3-5 cm long by 2-2.5 cm wide. During the feeding period the larvae spin a peculiar silken tube which is 3-5 cm long and 2-3 cm wide. Pupation takes place at the top of the silken tube in the root. The pupal stage lasts 10-11 days. The newly formed pupae are yellow pale, turning yellowish brown in a few days. Pupae measure 1 cm in length by 2 mm. in width. The adults began emergence in early August in the laboratory and continued emergence through the month. Oviposition was observed 2-3 days after a female's emergence and continued for 6-7 days. Adult *P. inspersa* females live 10-11 days and males 8-9 days. The newly deposited eggs are black with a little concavity in the middle. The eggs are 0.03 mm in length and 0.02 in width. The incubation period ranged from 16 to 19 days under natural day length and temperature. When eclosion occurs the first instar larva leaves the egg making a circular hole at the cephalic pole. No feeding on the corion was noted. During these observation no egg or larval parasite were obtained.

EXPERIMENTS

Larval survival test.

The experiment was set up in the greenhouse, using potted plants (temperature range of 20-25°C, RH 40-80% and a photoperiod of 14-15 hrs.). The following plants were selected: *Centaurea diffusa* (control), *Cynara scolymus*, *Grisanthemum leucanthemum*, *Centaurea diffusa* (Pulman, USA), and *Centaurea diffusa* (Spokane, USA). Mature eggs were transferred with a small brush to the test plants. Each egg position was previously marked, so that was possible to observe the eggs until eclosion. Daily checks were made to ascertain eggs fertility.

All the eggs placed on the plants hatched. A total of 5 replications were made using 5 eggs/plant test. 3 replications were dissected on November 20 without finding any larva (controls were also negative). The remaining 2 replications were dissected on Feb. 18, obtaining the same negative results. The test must be repeated in 1981. Before starting additional tests we plan to determine where the eggs are oviposited on the plant in nature. This information would hopefully help us in reducing larval stress.

Oviposition on host plant (*Centaurea diffusa*)

This test was set up in the greenhouse with a temperature range of 18-28°C, RH 40-80% and a photoperiod of 15 hrs. Plants were placed in 22 cm dia. pots over which was placed a clear plastic cylinder (dia. 21 x 56 cm height). Newly emerged adults 1♂ 1♀ (for a total of 5 pairs) were placed in these plastic sleeves over the plants. Under these conditions, *P. inspersa* laid eggs on leaf buds and on both leaf surfaces. Some eggs were found on the walls of sleeve cage. The eggs are well fixed on the leaf and may be oviposited singularly or in small groups. A total of 676 eggs were oviposited (135/♀) but only 125 were fertile.

COLLECTIONS

Sphenoptera jugoslavica (Col: Buprestidae) - Pecora, Campobasso

In order to collect adults of *S. jugoslavica* for shipping to Albany, Ca., on June 13-14, 1980, 800 roots of *Centaurea diffusa* were collected near Prespa lake (Macedonia), Greece. The rate of insect infestation was about 50%. From these roots, 184 alive adults were obtained in Albany, Ca.

400
18.4
23
23%

Sphenoptera jugoslavica (Col: Buprestidae) - Campobasso.

On June 18-19, 528 roots of *Centaurea diffusa* were collected in Kavala (Greece) and brought back to the Rome lab. At the beginning of July shipments of *S. jugoslavica* adults were made to Albany, Ca. In total 70 alive adults were sent out. Based on our observation, future collections should be made in Kavala instead of Prespa lake, because of the larger population in the former site.

Oberea erythrocephala (Col: Cerambycidae) - Campobasso, Laregina.

On July 14-17, 1980 a trip was made to Pisa, and Piacenza (Italy) to collect *O. erythrocephala* adults found on *Euphorbia esula* and *E. cyparissias*. A total of 140 adults were collected and shipped to Albany, Ca. The rate of infestation was 4-5%. Based on our field collection the best time to collect adults of *O. erythrocephala* was early in the morning 6-7 AM or late in the afternoon 7-8 PM. During the hot period of the day, the insects are very active and thus difficult to capture.

Ceutorhynchus trimaculatus - *Trichosirocalus horridus* (Col: Curculionidae) - Rizza, Campobasso, Laregina, Hostettler.

During November 1980 a collection of the above mentioned insects was made for shipping to Albany, Ca., using a mechanic vacuum. These locations were used for collection: Castel Porziano, Bracciano (Lazio, Rome), and Sila (Calabria). Rosettes of *Carduus nutans* were mechanically aspirated. The collected material was sifted to recover the aspirated insects. The insects were then checked under a microscope to verify sex, species and to remove dead or injured insects. Finally these insects were placed in individual small glass vials with a small *C. nutans* leaf and shipped to Calif. A total of 314 *T. horridus* and 340 *C. trimaculatus* were collected.

Rust on *Centaurea* spp. - Pecora, Campobasso.

A rust, probably *Puccinia jaceae*, was collected on *Centaurea diffusa*, in Bulgaria, along the Black Sea, between Slancev-briag and Plorie. In this area we found big plants of knapweed in the bud stage. Only the lower leaves were heavily infected by the pathogen. About 30% of the plants were attacked. The same rust was found in Greece near Alexandroupole and Portolagos, but here only 20% of the plants were infected. At Portolagos 2 plants of *Centaurea solstitialis* were found infected by *Puccinia centaureae*. These pathogens were collected from June 8 to June 10. Specimens of this rust were sent to Dr. A. Watson, Faculty of Agriculture, Canada; Dr. Emge, Frederick, Maryland, and to Dr. Defago, Zurich, Switzerland.

YELLOWSTAR THISTLE-CENTAUREA SOLSTITIALIS

Emanuele Piattella, Spencer, Rizza

Bibliographic research was conducted during 1980 to obtain biological data on the insects collected on *Centaurea solstitialis*. Insects in the Rome Laboratory collection "ex. *C. solstitialis*" that had been identified to genus were boxed and shipped to the British Museum for determination to the lowest possible level. Once the identifications were obtained, the bibliographic research was initiated.

The objective of a bibliographic research was to obtain a list of known host plants associated with the insects collected on *C. solstitialis* by the staff of the USDA-SEA-AR Biological Control of Weeds Lab-Europe and Univ. of Calif. scientists associated with the Laboratory.

This bibliographic research was conducted in the following steps:

- a) Search for references using the FAO Library's computerized data base for the years 1972-80.
- b) Search through the years 1913-1972 in "Review of Applied Entomology series A-Agricultural" and in the "Zoological Record".
- c) Search through many specific european references in the Library of the Zoological Institute at the Rome University, the Library of the Italian National Institute of Entomology, and through the publications in the USDA Laboratory in Rome.

No literature references were found for some 30 species collected from *C. solstitialis*. For these species queries have been sent out to specialists for the groups to which these species belong. The taxonomy of the genus *Larinus* (Coleoptera, Curculionidae) is unclear and needs revision. The Rome laboratory collection contained ca. 600 specimens identified as being in the genus *Larinus*. These specimens were from many different host plants including *C. solstitialis*. This collection of *Larinus* has been sent to Dr. Helmut Zwölfer for sorting and to compare with his very large *Larinus* collection from a variety of host plants.

The laboratories collection of *Urophora* (Diptera, Tephritidae) was sent to Dr. Richard H. Foote for determination. This genus contains some species that are commonly found attacking the seed heads of *C. solstitialis*. These specimens have not been returned at the time of this writing and thus have not all been included in the report.

Except for the groups of insects listed above the following insects in Table 3. are those species that appear to have the necessary specificity to be studied further as possible biocontrol agents for yellowstar thistle, *Centaurea solstitialis*,

Table 3. Insects collected on *Centaurea solstitialis*, which according to literature, appear specific to the genus *Centaurea*.

| Insect | Location | Date | Collector | Remarks | Literature Host Records |
|---|-------------------------------|---------|----------------------|-------------------|---|
| COLEOPTERA | | | | | |
| Curculionidae | | | | | |
| <i>Apion penetrans</i> Germ. | Novara, Sicily | 19-7-60 | L. Andres | Reared from plant | <i>Centaurea jacea</i> ; <i>C. nigra</i> ; <i>C. cyanus</i> ; <i>C. paniculata</i> <i>Carlina vulgaris</i> |
| | Ausonia, Italy | 23-7-63 | K.E. Frick | Reared from crown | |
| | Rosht to Gazin, Turkey | 14-5-71 | G. Buckingham | | |
| | 69mls N. Elozig, elv. 1500 m. | 18-5-71 | G. Buckingham | | |
| | 12mls N. Atalandi-Gr. | 31-5-71 | G. Buckingham | | |
| | Castel del Monte, I | 6-6-71 | G. Buckingham | On rosette | |
| | Foggia, Italy | 23-6-60 | L. Andres | Reared from root | |
| | | | | | |
| | | | | | |
| | | | | | |
| <i>Bangasternus orientalis</i> Cap. | 1.5mls E. Atalandi, Gr. | 31-5-71 | G. Buckingham | Shoots | <i>Centaurea nigra</i> |
| <i>Cyphocleonus morbillosus</i> F. var <i>gallicus</i> | Salerno, Italy | 13-7-59 | L. Andres | Reared from root | <i>Centaurea solstitialis</i> , |
| | Rome, Italy | 15-7-63 | K.E. Frick | Reared from root | <i>C. paniculata</i> |
| <i>Larinus canescens</i> Gyll. | Ausonia, Italy | 23-7-63 | K.E. Frick | Reared from head | <i>C. montana</i> subsp. <i>cugdunensis</i> |
| | Villarosa, Sicily | 17-7-61 | L. Andres | Reared from head | |
| | Triona, Sicily | 16-7-61 | L. Andres | Reared from head | |
| | Enna, Sicily | 17-7-61 | L. Andres | Reared from head | |
| | Favara bivio, Sicily | 18-7-61 | L. Andres | Reared from head | |
| | Ragusa, Sicily | 18-7-61 | L. Andres | Reared from head | |
| | | | | | |
| DIPTERA | | | | | |
| Tephritidae | | | | | |
| <i>Terellia virens</i> Loew. | Rome, Italy, newly emerged | 17-7-76 | Buckingham Pecora | | <i>C. rhenana</i> ; <i>C. maculosa</i> |
| <i>Urophora algira</i> Macq. | 10Km W. Ankara, Turkey | 21-4-71 | G. Buckingham | Flower heads | <i>C. sempervirens</i> collected on <i>Carthamus</i> (cited by Steyskal) |
| | 12Km N. Aliaga, Turkey | 26-5-71 | G. Buckingham | Shoots | |

Urophora quadrifasciata MG. 14Km N.Torrinpietra, I 27-7-76 *C.diffusa, Carthamus*
Torrevecchia, Rome 9-76 *Echinops, Serratula*
(cited by Steyskal)

Flowers

P.Pecora

Reared from head

K.E.Frick
P.Pecora

Rome, Italy 15-7-63
Torrevecchia, Rome, I 27-7-77

HYMENOPTERA

Cynipidae

Isocolus jaceae (Schenck)

10Km E.Edremit, Turkey 18-4-71
10Km W.Ankara, Turkey 21-4-71
Puglia, Italy 5-10-72

Ex overwinter heads

G.Buckingham
G.Buckingham
S.Rosenthal

C.jacea, C.paniculata,
C.scabiosa

Isocolus scabiosae Giraud

Arsoli, I 5-9-63
Rome, I 3-8-60
Sicily 7-59
9Km N.Raffadali, I 29-6-71

Reared from head
Reared from head
Reared from head
Flower heads

K.E.Frick
L.Andres
L.Andres
G.Buckingham

C.scabiosa

10Km W.Alexandroupolis 12-4-71
Greece
Kozani, Greece 4-4-71

Ex flowers

G.Buckingham

C.scabiosa

Ex overwinter heads

G.Buckingham

LEPIDOPTERA

Gelechiidae

Metzneria aprilella (H-S)

Castel del Monte, I 16-8-70

Flower heads

G.Buckingham

C.scabiosa

CENTAUREA SOLSTITIALIS
(Oct.20-Dec.20)
R. Sobhian

A careful study was made on samples of *C. solstitialis*, available in the herbarium of the Rome Laboratory. During this survey I made the following observations and conclusions:

- a) The 5 samples from Spain show the greatest morphological similarity with the samples from Dublin, Orinda, California (2). The number of samples is of course small, however it could be an indication that the California plants originated from Spain (further comparison, morphological and cytotaxonomical, is desirable). However, I suggest a collection of *Urophora* from Spain, this coming season, for introduction to California. They might be suitable for the Californian strain of *C. solstitialis*. (Perhaps Mr. F.R. Lawson could do this).
- b) I found diseased plants, collected from Castel del Monte, Italy, by Rizza 1961 and by Pecora 1975-76, with heavy deformations of leaves, flowerbuds, and branches. A microscopic preparation showed the fruiting bodies of a fungus. This fungus was identified by Prof. Müller (ETH Zurich) as *Erysiphe cichoracearum* DC (new record). A hyperparasite (*Cicinnobolus cessatii*?) was very common in the sample. A second sample also from Italy was infected with a rust (on leaves and stems). This rust was identified by Prof. Müller as *Puccinia centaurea* DC.

Mr. Don Maddox, USDA, Albany, Ca. suggested that we consider the following four candidates as potential biocontrol agents for *C. solstitialis*.

- A. *Larinus curtus*
- B. *Bangasternus provincialis*
- C. *Lixus speciosus*
- D. *Eriophyes centaurea*

A literature review suggests the following conclusions on the above candidates.

***Larinus curtus*:** According to H. Zwölfer (Report No. 6, May 1968), *L. curtus* fed on a number of Cynareae during laboratory tests. He also found that *L. curtus* adult ♀ fed on *C. solstitialis* leaves did not develop mature eggs in their ovaries. On the other hand Zwölfer pointed out that the results of the laboratory tests were not parallel to the field observations. Zwölfer, Frick and Andres (Tech. Bul. #14, 1971) reported *L. curtus* only on *C. solstitialis*. It would be advisable to find out whether *L. curtus* could breed on any plant other than *C. solstitialis* (see P. Dunn's thoughts on cage tests in the Proceedings of the IV Int. Symp. on Bio-Control of Weeds).

***Bangasternus provincialis*:** After Hoffmann 1950, the host range of this species is restricted to the genus *Centaurea*. This means that this beetle is an oligophagous species. The first step of testing this candidate would be to find out if it would feed or breed on artichoke and safflower.

***Lixus speciosus*:** This species should be polyphagous (Hoffman 1950).

***Eriophyes centaurea*:** A literature survey showed the following host plants for this mite: *Centaurea amara* L., *C. maculosa* Lam., *C. scabiosa* L., *C. aspersa*, *C. jaceae* and *C. austriaca* Wild. Jepperson, Keifer and Baker 1975, in "The mites injurious to Economic Plants" did not mention this mite. The evaluation of this mite as a potential biocontrol agent is strongly recommended (see paper by Dr. Harvey L. Cromroy, IV Int. Symp. on BioControl of Weeds).

In considering the fact that for some 20 years Entomologists have been looking for the biocontrol of *C. solstitialis* without finding suitable candidates, and in reviewing the Proceedings of Knapweed Symposium, Oct. 6-7, 1977, the reports in the IV Int. Symp. on BioControl of Weeds and other literature, I have the feeling that we should turn our attention more to plant pathogens (Prof. Zwölfer supported this idea via personal correspondence) and Dr. K. Brunetti (State of Calif. Plant Pathologist) recommended the evaluation of *P. ourmiahensis* as a potential biocontrol agent against *C. solstitialis*. Puccinia

A trip to Switzerland (ETH Zurich) and Austria (Vienna, Museum and University) Nov. 16-30, 1980, was planned for the following reasons: a) to take the infected material for identification; b) to contact specialists for further investigations and identification of material; c) to do a literature survey on fungus and mites, and also to make a survey on the insects collected from *C. solstitialis* by various colleagues (this list is still not completed); d) to check the herbaria for *C. solstitialis* for diseased plants, variability and distribution; e) and finally to become familiar with methods for collecting, rearing and testing of plant fungi.

In Vienna I visited Prof. Burian (a friend of mine) at the Univ. of Vienna, Dept. of Botany, Div. of Physiology, asking him if he would make a chemical comparison on various biotypes of *C. solstitialis* (US and European plants). He is ready to do this when we provide him with seeds. He said he does not need any financial support.

I also visited Dr. Fischer at the Div. of Plant Systematic (Univ. of Vienna) asking him if he would do a similar survey on cytotaxonomical basis. He also volunteered, but in this case some financial support would be necessary.

The final decision depends on USDA authorities.

I thank all the colleagues in ETH, Zurich, Museum of Natural History, Vienna and University of Vienna for their cooperation and help.

The fungi reported on *C. solstitialis* L. (based mainly on Petrak index 1920-1939 and index of fungi (Kew Index) 1940-1977).

1. *Puccinia jaceae* Oth. var. *solstitialis*
2. *Puccinia centaurea* D.C.
3. *Puccinia ourmiahensis*
4. *Pleospora centaurea* J.
5. *Erysiphe cichoracearum* D.C. (new record, see this report)

Other host records for some of these pathogens are:

- a. for *P. centaurea*: var. *diffusa* on *Centaurea diffusa*, *C. sonchifolia*; var. *hellenica* on *C. mixta*, *C. virgata*.
- b. for *Pleospora centaurea*: *Centaurea emeroides*.
- c. for *Erysiphe cichoracearum*: there are over 100 forms of this species on various plants reported, which indicates that very often it is specific to a particular plant species. Hasan has been studying one form of this species on *Chondrilla juncea* (Freeman et al., IV. Int. Symp. on Weeds).

1981 Plan of Work.

1. Set up a substation at the Plant Protection Institute, Thessaloniki, Greece for a long term study on the biological control of *Centaurea* species - Yellowstar thistle, diffused knapweed and spotted knapweed.
2. Plant a garden of US *C. solstitialis* and see what attacks it in Greece.
3. Survey for biotic agents (including pathogens) of *C. solstitialis* in Greece, Turkey and the Balkans.
4. Test *Urophora* and other collected insect species on european and US *solstitialis* as well as selected economic plant species closely related to the genus *Centaurea*.
5. Make collections on other targeted weeds of interest to the Rome Laboratory as requested.
6. Conduct other studies as requested by the Rome Laboratory.

Table 4. Morphological comparison of Californian samples of *C. solstitialis* and the samples in the Nat. History Museum, Vienna, Austria.

| Countries of origin of plant samples | Number of specimens examined | | | | | |
|--|------------------------------|---|---|---|-----------------|---------------|
| | Similar 4 | 3 | 2 | 1 | dissimilar 0 | |
| Austria | 1 | 8 | 2 | | | sp.atlanticon |
| Yugoslavia | 1 | 4 | 2 | 1 | 2 | sp.atlanticon |
| Albania | | 1 | | | 1 | |
| France | | 1 | 1 | 2 | | |
| Iran | | 1 | 3 | | | |
| Italy ? | | 4 | 1 | 4 | 4 | |
| Turkey | | 2 | 2 | | 2 | |
| Germany | | | 1 | | 1 | |
| Bulgaria | | | 2 | 1 | 1 | |
| Romania | | | 1 | | 1 | |
| Hungary | | | 3 | | 12 | |
| USSR | | | | 1 | 4 | |
| Greece | | | 4 | 2 | 1 | |

Diseased plants (*Erisyphe cichoracearum?*): 2 samples from Pula (Yug.) one from Macedonia (Greece)

EFFECTS OF AN ENTOMOPATHOGENIC MICROSPORIDIAN NOSEMA SP. ON A COLONY OF GALERUCA RUFA.

Francesca Murano, N. Spencer, A. Rizza

The impact of *Nosema* sp. on *Galeruca rufa* has been studied through a series of comparisons between a colony of *G. rufa* naturally infected with a *Nosema* sp. and a colony of *G. rufa* from the same area that has been cleansed of the diseased organism. The criteria used to evaluate the effect of the microsporidian organism on the colony were:

Larval developmental time; Larval feeding; Duration of pupal period; Preoviposition period; Oviposition period; Number of eggs per female; Length of egg stage; ♂ longevity; ♀ longevity; Amount of feeding (♂ and ♀).

The biology of the two colonies has been studied in the Rome Lab in two climatic chambers under the same conditions: 15 hr photoperiod, temperature between 22°C (dark phase) and 24°C (light phase); 70-80% humidity.

The diseased colony was started from eggs oviposited by adults collected on the first days of May, 1980 at Ponte Milvio (Rome, Italy). The disease free colony was started from eggs received from the USDA Lab in Albany, Ca. The origin of this disease free colony was from individuals collected at the same site as the diseased stock and shipped to California for cleansing.

The colonies were handled in two different rooms, located in two different lab areas and all the material used (separated for each colony) was sterilized after usage with a 6% solution of sodium hypochlorite and 95% ethyl alcohol. Eighty newly emerged larvae were used to study larval development. Forty of these larvae were taken from diseased adults. (Smears of females that produced the eggs showed protozoan spores). The other 40 larvae were obtained from disease free eggs received from Albany, Ca. Each larva was individually reared in a 450cc unwaxed paper cup and checked daily. Leaves bouquets were changed 3 times/week and the amount of food eaten was measured in mm². In case of death the larvae were examined under the microscope to determine the presence of *Nosema* sp. spores.

To obtain biological data, 18 pairs of newly emerged adults/group were used. Each pair was reared in a 950 cc cardboard container, and checked 3 times/week. All dead insects were examined under the microscope to ascertain the presence or absence of *Nosema* spores. The eggs were recorded on the day produced and placed in small eclosion containers.

Thirty days after the last oviposition, all the remaining living insects were killed and checked with a microscope for disease.

The effects of the *Nosema* species on food consumption and longevity on adult *G. rufa* were measured by rearing 20 adults from the diseased and disease-free colony individually in 450 cc unwaxed cardboard containers. The adults were set up in the containers on the first day of their emergence and fed with leaf bouquets of *Convolvulus arvensis*. The bouquets were changed twice weekly and the amount consumed by each individual beetle measured in mm². The experiment was continued until all individuals had died.

Table 5 shows the development time in days and food consumption for diseased and disease free *G. rufa*. An unpaired "t" test was used to compare the development time for each stadium. Only the first instar and pupal stadia were significantly different at $P < 0.05$ for diseased and disease free individuals. Consumption of *Convolvulus arvensis* leaves was significantly higher ($P < 0.05$) for diseased larvae in the II and III stadia in comparison to non diseased larvae.

Disease free females laid significantly more eggs over a longer period of time than diseased females (Table 6).

The longevity and food consumption was significantly higher for disease free adults (Table 7). It would appear that the *Nosema* infected insects are more affected as adults and these effects can be seen in the disparity in the number of eggs, longevity and the amount of leaf material consumed by the adults.

Table 5 . Developmental time and food consumption of *Galeruca rufa* larvae.

| Instars | No. Individuals | Duration of stadia in days | Food consumption (mm ²) |
|-----------------------------------|-----------------|----------------------------|-------------------------------------|
| Diseased <i>Galeruca rufa</i> | | | |
| I | 36 | 5.2 [±] 0.9* | 26.4 [±] 14.6 |
| II | 36 | 5.8 [±] 1 | 78.8 [±] 35.1* |
| III | 33 | 9.3 [±] 1.4 | 146.8 [±] 54.3* |
| Pupa | 32 | 8.2 [±] 1.2* | |
| Disease free <i>Galeruca rufa</i> | | | |
| I | 37 | 4.5 [±] 0.8* | 22.3 [±] 9.8 |
| II | 35 | 6.1 [±] 1.1 | 56.8 [±] 30.3* |
| III | 33 | 8.8 [±] 1.4 | 105.9 [±] 48.2* |
| Pupa | 31 | 7.4 [±] 1.4* | |

Table 6 . Biological data of diseased and disease free *Galeruca rufa*.

| | Diseased Mean + SD | Disease free Mean + SD |
|---------------------------------|------------------------|---------------------------|
| Preoviposition period (days) | 25.3 [±] 6.5 | 22.4 [±] 6.4 |
| Oviposition period (days) | 13.9 [±] 12.8 | 24.3 [±] 17.2 |
| Fecundity (# eggs/♀) | 66.9 [±] 96.5 | 172.6 [±] 167.1* |
| % eggs viability in %/eggs laid | 28.5 [±] 20.1 | 30.5 [±] 19 |
| Hatching period (days) | 10.9 [±] 1.4 | 10.8 [±] 1.4 |

* χ^2 is statistically different ($P < 0.05$) between diseased and disease free individuals.

Table 7. Longevity and food consumption of adults Galeruca rufa.

| | Disease free | | Diseased | |
|----------------------------------|---------------------------|---------------------------|---------------------------|------------------------|
| | ♀ (10) | ♂ (10) | ♀ (10) | ♂ (10) |
| Longevity (days) | 114.4 [±] 40.8 | 116.8 [±] 62.2 | 31.1* | 15.4* |
| Range (days) | 56 - 172 | 7,191 | 4 - 71 | 5 - 615 |
| Food consumption mm ² | 2215.5 [±] 872.2 | 989.1 [±] 474.4* | 296.3 [±] 315.3* | 90 [±] 152.2* |
| Range (mm ²) | 1148 - 3066 | 10 - 1458 | 5 - 615 | 4 - 460 |

* = χ^2 is statistically different ($P < 0.05$) between diseased and disease free adult beetles.

RUMEX CRISPUS

N. Spencer and N. Hostettler

Additional tests were conducted during 1980 on the host specificity of *Pyropteron chrysidiforme* (Lepidoptera, Sesiidae) (Sensu Naumann, 1971). Also, additional data on the biology of the potential biocontrol agent has been gathered.

Seeds of *Rumex crispus* were gathered over a wide area of Europe and held over the winter (1980-81) to determine what seed predators might be present. A list of the areas which the seeds were taken as well as the species of *Rumex* is given in Table 8. Additional biotic agents were collected from *Rumex* species in 1980 that had not been listed in earlier reports or had not been identified before. These biotic agents are listed in Table 9. The species listed in Table 9 should be considered as an addendum to the table on insects from *Rumex* sp. in the 1979 Annual Report. Table 10 is a list of Mycoflora recorded from *Rumex* or from the Polygonaceae. The table was prepared by Dr. G. Defago, of the Institut für Phytomedizin, Zurich, Switzerland. Several of the plant pathogens collected in Europe on *Rumex* spp. appear to be promising as bioherbicides for *Rumex* species.

The major effort on this project during 1980 was directed towards *P. chrysidiforme*. Studies were conducted on its biology and experiments were designed to further elucidate the host range of this promising biocontrol agent.

Pyropteron chrysidiforme

If it is difficult to impossible to predict the incidence of sesiid attack on *Rumex crispus* by gross observations, it would appear that the adult female finds the plants visually since plants in situation where other species are competing successfully with *R. crispus* are generally less infested than those in open situations. Areas in which *Rumex* is occasionally flooded will have a very poor *P. chrysidiforme* population.

P. chrysidiforme may be found in just a few plants in areas where *Rumex crispus* is randomly scattered or 100% of the plants may be infested. The sesiid may be parasitized by the Tachinid, *Bithia modesta* Meigen. Levels greater than 60% have been found, however when high densities of *P. chrysidiforme* are found in *Rumex*, parasitism is less than 15%.

Two additional root borers are found in *Rumex* in the Lazio region (Rome area) of Italy. They are, *Capnodis tenebricosa* (Oliv.) (Coleoptera, Buprestidae) and *Lixomorphus ocularis* (F.) (Col. Curculionidae). *C. tenebricosa* is quite common in Italy and one larva may destroy the interior of a *Rumex* root. A high infestation of *C. tenebricosa* indicates a low *P. chrysidiforme* population level. *Lixomorphus ocularis* is rarely found, however, when it is found in the root it appears to be less competitive with *P. chrysidiforme*. In one case south of Rome (Settecamini), we encountered a group of *Rumex* plants with all three larvae present in all of the plants.

Collecting *P. chrysidiforme* in the field.

In the autumn, *Rumex crispus* plants were dug from the ground in areas within 150 km. of Rome. The tips of the roots were cut to check for tunneling and frass. As a check on the species present in the root, a few plant roots were completely dissected at each collection site. The frass of *P. chrysidiforme* is somewhat characteristic for the species and thus an indication that the damage found in a

Table 8. Collecting locations of *Rumex* seeds.

| Province/Department | Country | Plant species | # plants |
|---------------------|---------|--------------------------|----------|
| Rome | Italy | <i>crispus</i> | 60 |
| " | " | <i>conglomeratus</i> | 1 |
| Seine et Marne | France | <i>crispus</i> | 10 |
| " | " | <i>obtusifolius</i> | 10 |
| " | " | | 5 |
| Yvelines | " | <i>obtusifolius</i> | 25 |
| Eure | " | <i>obtusifolius</i> | 35 |
| Siedleckie | Poland | sp.prob. <i>patienta</i> | 10 |
| Bialystockie | " | prob. <i>aquaticus</i> | 1 |
| Lomzynskie | " | sp.prob. <i>patienta</i> | <10 |
| Olsztynskie | " | sp.prob. <i>patienta</i> | <10 |
| Elblaskie | " | sp.prob. <i>patienta</i> | <10 |
| Cdanskie | " | sp.prob. <i>patienta</i> | <10 |
| Koszalinskie | " | sp.prob. <i>patienta</i> | <10 |
| Lesnzeynskie | " | sp.prob. <i>patienta</i> | <10 |

Not all the seeds were taken, but average sample of each plant: small plant: all; large plant: half.

Table 9. Additional insects found on *Rumex crispus* or identified since the 1979 Annual Report.

| Insect | Site | Month | Stage | Where Found |
|--|---------------------------|------------------|-------|-----------------------|
| Coleoptera | | | | |
| Chrysomelidae | | | | |
| <i>Phyllodecta laticollis</i> Suffr. | Poland, Woj. Bialostockie | July 80 | adult | on seed stalk |
| <i>Mantura rustica</i> (L.) * | France, Herault | Nov. 79 | " | on crown |
| Bruchidae | | | | |
| <i>Bruchidius meleagrinus</i> (Gene) | Maccarese, Italy | Aug. 80 | " | on seed stalk |
| <i>B. sericeatus</i> (Germar) | " | " 80 | " | " |
| Phalagridae | | | | |
| <i>Olibrus affinis</i> (Sturm) | " | Dec. 77, Apr. 78 | " | on crown, in detritus |
| " | L'Aquila, | Jan. 78 | " | " |
| <i>O. bicolor</i> | " | Nov. 78 | " | in detritus |
| Curculionidae | | | | |
| <i>Apion curtirostre</i> Germar * | Poland, Woj. Bialostockie | July 80 | " | on leaf |
| " | " Siedleckie | " 80 | " | on stem |
| <i>Sitona cambricus</i> Steph. | Maccarese, Italy | Sept. 78 | " | in crown |
| <i>S. ophtalmicus</i> Desbr. | " | June 78 | " | on " |
| <i>S. lineatus</i> (L.) | " | Sept. 78 | " | in " |
| " | L'Aquila, | Nov. 78 | " | on, in crown |
| <i>Nanophyes nitidulus</i> Gyll. | Castel Porziano, Italy | Jan. 78 | " | on crown |
| <i>Chromoderus fasciatus</i> (Mueller) | Poland, Woj. Bialostockie | July 80 | " | on seed stalk |
| Scarabaeidae | | | | |
| <i>Pleurophorus caesus</i> (Creutz.) | Latina, Italy | Mar. 79 | " | on crown |
| <i>Rhizotrogus ciliatus</i> Reiche | L'Aquila, | Nov. 78 | " | in soil |
| Staphylinidae | | | | |
| <i>Philonthus concinnus</i> (Grav.) | Castel Porziano, Italy | Jan. 78 | " | on crown |
| <i>Tachyporus hypnorum</i> (L.) | " | " 78 | " | " |
| Elateridae | | | | |
| <i>Drasterius bimaculatus</i> (Rossi) | " | " 78 | " | " |
| Carabidae | | | | |
| <i>Dromius linearis</i> (Oliv.) | Rome, Italy | Aug. 80 | " | on seed stalk |
| Byrrhidae | | | | |
| <i>Simplocaria semistriata</i> (F.) | Maccarese, Italy | May 78 | " | on crown |
| Alleculidae | | | | |
| <i>Megischia curvipes</i> (F.) | Lab. Rome, | June 78 | " | in detritus |
| Dermestidae | | | | |
| <i>Dermestes mustelinus</i> Er. | Maccarese, | Sept. 78 | " | in crown |
| Corylophidae | | | | |
| <i>Sacium</i> sp. | " | Aug. 80 | " | on seed stalk |

| | | | | | | |
|---|---------------------------|----------|---------------|---------------------|--|--|
| Scraptiidae | | | | | | |
| <i>Anaspis regimbarti</i> Schils. | Lab. Rome, Italy | June 78 | adult | on flower | | |
| Psocoptera | | | | | | |
| Trogiidae | | | | | | |
| <i>Trogium</i> sp. | Maccarese, " | Aug. 80 | " | on seed stalk | | |
| Diptera | | | | | | |
| Anthomyiidae | | | | | | |
| <i>Craspodochoeta pullula</i> (Zetterstedt) | Lab. Rome, " | May 79 | " | | | |
| Hymenoptera | | | | | | |
| Ichneumonidae | | | | | | |
| <i>Eoichus nigripalpis</i> Thomson | Poland, Woj. Bialostockie | July 80 | " | in insect | | |
| <i>Alexeter</i> sp. | Maccarese, Italy | May 78 | " | " | | |
| Braconidae | | | | | | |
| <i>Manocentrus</i> sp. | Poland, Woj. Bialostockie | July 80 | pupa | in soil | | |
| <i>Apanteles amesis</i> Nixon | Avezzano, Italy | Nov. 78 | " | in insect | | |
| Chrysididae | | | | | | |
| <i>Hedychrum</i> sp. | Maccarese, " | Aug. 80 | adult | on seed stalk | | |
| Hemiptera-Heteroptera | | | | | | |
| Anthocoridae | | | | | | |
| <i>Andiaethus nazaremus</i> Reuter | " | " 80 | " | " | | |
| Lygaeidae | | | | | | |
| <i>Scelopostethus decoratus</i> (Hahn) | Castel Porziano, Italy | Jan. 78 | " | on crown | | |
| <i>Aoploscelis bivingatus</i> (Costa) | " | " 78 | " | " | | |
| <i>Piocoris erythrocephalus</i> (P&S) | " | " 78 | " | " | | |
| Lepidoptera | | | | | | |
| Arctiidae | | | | | | |
| <i>Arctia caja</i> L. | Vicenza, " | Oct. 78 | larva | on leaf | | |
| <i>Phragmatobia fuliginosa</i> L. | " | " 78 | " | " | | |
| Geometridae | | | | | | |
| <i>Lycia hirtaria</i> Cl. | Maccarese, " | June 78 | " | on fruit | | |
| Noctuidae | | | | | | |
| <i>Mythimna vitellina</i> Hb. | Rome, " | Feb. 79 | " | on leaf | | |
| <i>Noctua comes</i> Hb. | Lab., Rome, " | June 79 | adult | in cage | | |
| <i>Ochropleura plecta</i> L. | Vicenza, " | Oct. 78 | larva | on soil | | |
| <i>Acrionicta rumicis</i> L. | Rome, " | Sept. 78 | " | on leaf | | |
| <i>Xestia xanthographa</i> Schiff. | L'Aquila, " | Nov. 78 | " | " | | |
| <i>Dypterygia scabriuscula</i> L. | Rome, " | Sept. 78 | " | " | | |
| <i>Hydraecia micacea</i> Esp. | Poland | July. 80 | larvae, pupae | in root stalk, soil | | |

Tortricidae

Cacoecimorpha pronubana Hb.

Lycaenidae

Heodes tityrus Poda *

| | | | | |
|------------|---|---------------|--------------------|----|
| Lab., Rome | " | Jun., Mar. 79 | pupa, adult. larva | " |
| L'Aquila, | " | Nov. 78 | larva | ". |

* According to literature records, may be specific to *Rumex* spp.

Table 10. Mycoflora on *Rumex crispus* L. and *R. obtusifolius* L. ex Dr. Genevieve Defago, Zurich, Switzerland

| Fungus | part of plant | country of occurrence | <i>R. crispus</i> | other hosts | reference |
|--|-----------------------------------|-----------------------|-------------------|----------------------------------|--|
| ASCOMYCOTINA⁺ | | | | | |
| Discomycetes: | | | | | |
| <i>Pezizella dura</i> Velen. | leaves | Czechosl. | | <i>Rumex</i> sp. | ⁰ Monogr. Discomycet. Bohem.: 161; 1934 |
| <i>Sclerotinia microspora</i> Velen. | nerves | " | | <i>Rumex</i> L. | ol.c.: 226; 1934 |
| <i>Septatium rumicis</i> Velen. | achenes | " | | <i>Rumex</i> sp. | ol.c.: 213; 1934 |
| Loculoascomycetes: | | | | | |
| <i>Gloniopsis levantica</i> Rehm. | stems | England | | <i>Rumex</i> sp. diff. woody pl. | Bisby G.R., Hughers S.J.: Trans. Br. mycol. Soc. 35: 308; 1952. |
| <i>Mycosphaerella insulana</i> Bub. et Syd. | dead stems | Eurasia | | <i>Rumex</i> spp. | Tomilin B.A.: Oprelitel gribov roda. Mycosphaerella Johans.: 203; 1979 |
| <i>M. leptasca</i> Auersw. | | | | diff. genera | l.c.: 275; 1979 |
| <i>M. polygonarum</i> (Crie) Lind | dead leaves | | | Polygonaceae | l.c.: 203; 1979 |
| * <i>M. rumicis</i> (Desm.) W.B. Grove | | | | | J. Bot. 71: 253; 1933 |
| *-- <i>f. caulicola</i> W.B. Grove | stems | Gr. Br. | | <i>R. pulcher</i> L. | l.c.: 253; 1933 |
| * <i>Venturia rumicis</i> (Desm.) Wint. | living leaves | | x x | <i>Rumex</i> spp. | Kerr J.F.: Trans. Br. mycol. soc. 44: 465; 1961 |
| Pyrenomycetes: | | | | | |
| <i>Amphorulopsis polygonacearum</i> Petrak | dead stems | Czechosl | | <i>Rumex</i> L. | Sydowia 13: 183; 1959 |
| <i>Diaporthe aretii</i> (Lasch) Nits. | | | x x | | D.M. Henderson in: Cavers B.P., Harper J.L.: J. Eco. 52: 737; 1964 |
| <i>Erysiphe polygoni</i> DC ex St. Amans | leaves | | x x | Polygonaceae | Blumer S.: Echte Mehltäupilze: 220; 1967 |
| * <i>Leveillula</i> sp. | leaves, stems | S. Europe | x | | l.c.: 333; 1967 |
| BASIDIOMYCOTINA | | | | | |
| Hymenomycetes: | | | | | |
| <i>Armillaria mellea</i> (Vahl) ex Fr.) Kummer | spread. from tree trunks to docks | | x x | | Salmon 1923, in: Cavers B.P., Harper J.L.: J. Ecol. 52: 737; 1964 |

| | | | | |
|------------------------|--------------------|---|--------------------------------------|--|
| Leaves | Europe USA | x | <i>Polygonum</i> spp. | Zunder G.L.:The Ustilaginales of the world: 144; 1953 |
| stems, lvs, ovaries | W.China Eurasia | x | <i>Rumex</i> L. <i>Rumex</i> spp. | Acta Bot.Sinica 10:133; 1962 Zundel G.L.:The Ustilaginales of the world: 174; 1953 |
| stems, petiol | Eur., Amer. | x | <i>Rumex</i> spp. | l.c.:189; 1953 |
| lvs., inf. | Europe | x | <i>Rumex</i> spp. | l.c.: 220; 1953 |

*11. *hsui Wang Yun-Chang*
*12. *kuehneana Wolff*

**U. warmingii* Rostrup

| Coelomycetes: | | | |
|--|--------|------------|-----------------|
| <i>Chaetopyrena ruminicina</i> | stems | W. Pakist. | <i>Rumex</i> L. |
| * <i>Colletotrichum ruminis-crispi</i> | leaves | Taiwan | x |
| Sawada | | | |

Diplodina volubilis (Sacc. et

Hendersonia ruficis Losa

Patouillardiella rumicis

Phoma herbarum Westend

*ph. runcicis G. Frag.

et Roum.) Died

var. *rubicis* Grove

| | | | | | |
|---|------------------|-----------------------|--|---|---|
| <i>Acrostalagmus cinnabarinus</i> Cda.var. <i>pentatus</i> Cif. * <i>Alternaria rumicicola</i> Mathur Agnihotri et Tyagi * <i>Cercospora rumicis</i> Ellis et Langlois | leaves leaves | Italy India USA | <i>Rumex</i> sp., <i>Vitis vinif.</i> L. <i>Rumex</i> L. | 0 Annal.Mycol. 20:50; 1922 0 Curr.Sci. 31: 297; 1962 | Chupp C.: A monograph of the genus <i>Cercospora</i> : 453; 1954 |
|---|------------------|-----------------------|--|---|---|

Cda. var. *pentatus* Cif.

Mathur Aanihotri et T

Ellis et Langlois

CHIS ET LANGLOIS

| | | | | |
|--|-------------|------------------------|--|--|
| <i>Chalara unceolata</i> Nag Raj et Kendrick | | Gr.Br., N.Z. | <i>Rumex</i> sp. and other plants | A monograph of Chalara and allied genera: 139; 1975 |
| * <i>Ovularia obliqua</i> (Cooke) Oudem. | leaves | world-wide | x <i>Rumex</i> spp. | Laibach F.: Ctrbl. Bakt. Parasit. Infkr. 55: 284; 1921 |
| <i>Penicillium glaucoroseum</i> Dem. | dead plants | Austria | <i>Rumex</i> L. | Verh. Zool. Bot. Ges. 72: 66; 1923 |
| <i>Ramularia decipiens</i> Ellis et Everh. | leaves | Eu., India, N. America | <i>Rumex</i> spp., <i>Ranunculus sceleratus</i> L. | Subramanian C.V.: Hyphomycetes: 439; 1971 |
| <i>R. rubella</i> (Bon.) Nannf. | leaves | | x x | Cavers P.B. in: Cavers P.B., Harper J.L.: J. Ecol. 52: 737; 1964 |
| * <i>R. rumicis crispis</i> Sawada | | Formosa | x | Rep. Govt. Res. Inst. Formosa 85: 89; 1943 |

+ Classification of higher taxa according to: Ainsworth G.C. et al. (eds) The Fungi IV; 1973

* event. interesting as possible control agent.

0 excerpted from Index of Fungi CMI (1940-) or from Petrak's Lists (1921-1939)

Rust fungi (Uredinales) on *Rumex crispus* L. (1) and *R. obtusifolius* L. (2)

| Rust fungus | country of oc- currence | develop. (stage) | haphophase | host range | dikaryophase | reference |
|---|-------------------------------|---------------------|--|---------------------------------|---------------------------|--|
| <i>Aecidium minutulum</i> H.S.Jackson | USA | ? | <i>Rumex</i> L. | ? | | OBartholomew E.: N.Amer. Ured., 3401; 1926 |
| <i>Puccinia orientalis</i> Otani et Akechi | Japan | (0,I) ? | | | 1, <i>R.comesticus</i> L. | Trans.mycol.Soc.Jap. 3: 130; 1962 |
| * <i>P. otaniana</i> Hiratsuka f. nom. nov. (= <i>P.orient.</i> Ot.&Ake.1962) | | (II,III) | | | | |
| <i>P. phragmitis</i> (Schum) Korn. | n.hemisph. | hetereu | 1,2, <i>Rumex</i> a. <i>Rheum</i> spp. | <i>Phragmites</i> spp. | | 1.c.8: 11; 1967 |
| <i>P. trailii</i> Plowright | Europe | hetereu (0-IV) | 1,2, a.o. <i>Rumex</i> | <i>Phr.communis</i> Trin. | | Gaumann E.: Rostpilze Mitteleuropas: 746; 1959 |
| <i>Schroeteriaster alpinus</i> (Schroet.) Magn. | Europe exc.North | hetereu (0-IV) | <i>Ranunculus</i> spp. | 1,2, a.o. <i>Rumex</i> spp. | | 1.c.: 425; 1959 |
| * <i>Uromyces rumicis</i> (Schum.) Wint. | cosmopolitan | hetereu (0? I-IV) | <i>Ranunculus ficaria</i> L. | 1,2, a.o. <i>Rumex</i> spp. | | 1.c.: 306; 1959 |
| --f.sp. <i>aquaticus</i> Gm. | | ditto | ditto | <i>R.aquaticus</i> L. main host | | Annal.Mycol.29: 404; 1931 |
| *--f.sp. <i>obtusifolii</i> Gm. | | ditto | ditto | 1=main host | | 1.c.: 404; 1931 |

+ as in Mycoflora list
 * 0 = pycnia
 I = aecia
 II = uredia
 III = telia
 IV = basidia
 ? =

root was caused by this species. The frass is fine, dense and dark reddish-brown in color. Older, dry frass is often light brown. In mid summer, *P. chrysidiforme* larvae spin a silky tube within the root from which they feed. The bottom of the tube contains frass and the top is open.

Hard and healthy roots containing *P. chrysidiforme* larvae were stripped of leaves (since they die back during the winter), and were transplanted in the lab garden in Rome. Roots that were in poor condition were dissected and the *P. chrysidiforme* removed. New *R. crispus* roots which had been grown in the lab garden were bored with a 3 mm cork hole borer to provide an entrance for the larvae removed from substandard roots. To avoid cannibalism only one larva was placed in a man made tunnel and only one larva per root was set up unless the *Rumex* root was particularly large.

In May the plants containing the Sesiids were covered with a cage in preparation for the adult emergence. When adults began to emerge in June the cages were checked around 2 P.M. daily for new adults. Adults emerged from mid-June to mid-July (Fig. 2). No adults were seen in the cages before 10:00 A.M. or after 2:00 P.M. The four hour emergence period coincides with the warmest period for the cages; when the sun is shining directly into them.

The activity of the adults follows the sun and the outside temperature. Thus a cloud covering the sun has been seen to stop the flight of adult *P. chrysidiforme*.

Females appear to "call" males with a sex pheromone, a trait common in the sesiidae. When a female *P. chrysidiforme* is in a "calling" posture the males in the same cage become excited and little time is lost in finding the "calling" female.

Females begin laying eggs individually soon after mating, but egg laying is also a function of the midday activity of the adult females. Figure 3 shows the production of the individual females in the form of a histogram. The mean number of eggs for the 12 females was $488 \pm \text{SD } 163$, with a range of 241 to 790. The mean larval production was $343 \pm \text{SD } 94$ with a range of 208 to 518.

The eggs of *P. chrysidiforme* are black, thick and leathery. Unfertilized eggs may not collapse as is often the case with eggs with a more pliant chorion.

Hatching larvae have been observed to crawl down the stem of a *Rumex* plant and enter the soil around the plant stem or root. Others may enter the plant at the base of a petiole or stem.

Host specificity.

Figure 4 is a three dimensional plot of a test begun on July 14, 1980 where 5 *P. chrysidiforme* were placed on 6 replicated species of *Rumex* and on rhubarb, *Rheum rhabarbarum*. Every two weeks thereafter one *R. crispus* and one *R. rhabarbarum* were dissected and examined for *P. chrysidiforme* larvae. Once a month each of the other five species of *Rumex* were dissected in the same manner. Figure 4 shows the number of larvae found when each of the test plants was dissected. There is no significant difference at $P < 0.05$ between the numbers of larvae found in the *Rumex* species. However, there is a significant difference between the numbers of larvae found in any of the *Rumex* species and those found on rhubarb. We have not been able to rear *P. chrysidiforme* through to the adult stage on rhubarb although we have tried for three years. The plant will support larval development to some degree, however we have noted that either some essential nutrient(s) are lacking or that the plant has some type of defense that restrict *P. chrysidiforme* larval development.

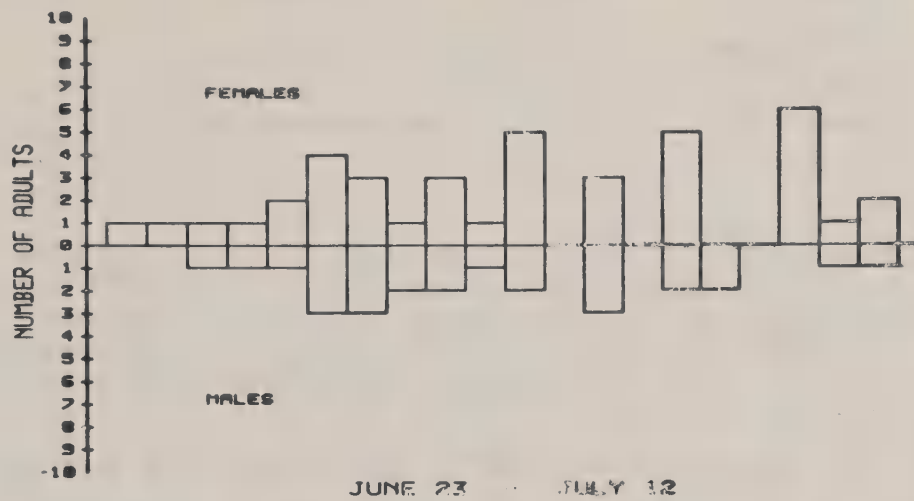


Fig. 2. Numbers of adult male and female *Pyropteron chrysidiforme* emerging from *Rumex crispus* roots in Rome, Italy - June 23 to July 12, 1980.

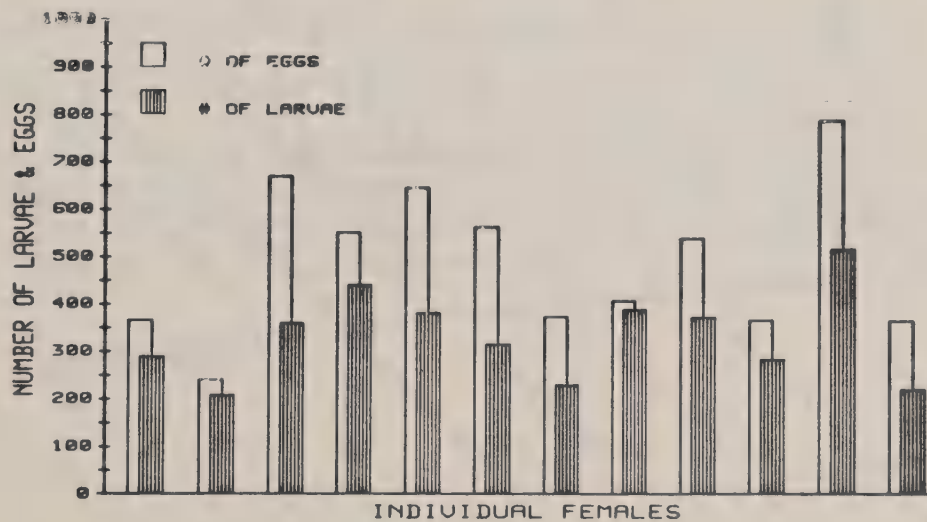


Fig. 3a. Number of eggs produced by each of 12 mated *Pyropteron chrysidiforme* and the resulting neonates produced from the same eggs (viability).

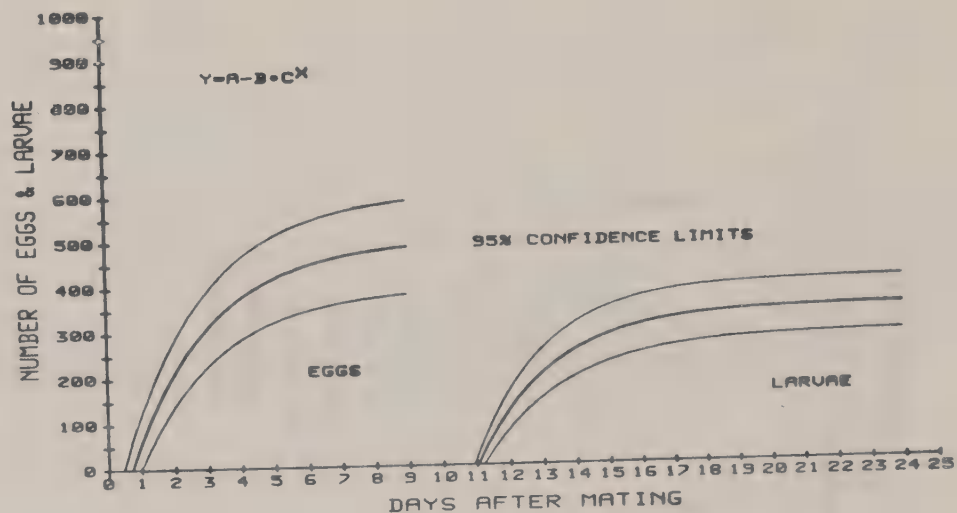


Fig. 3b. Regression analysis of data shown in 3a with 95% confidence limits.

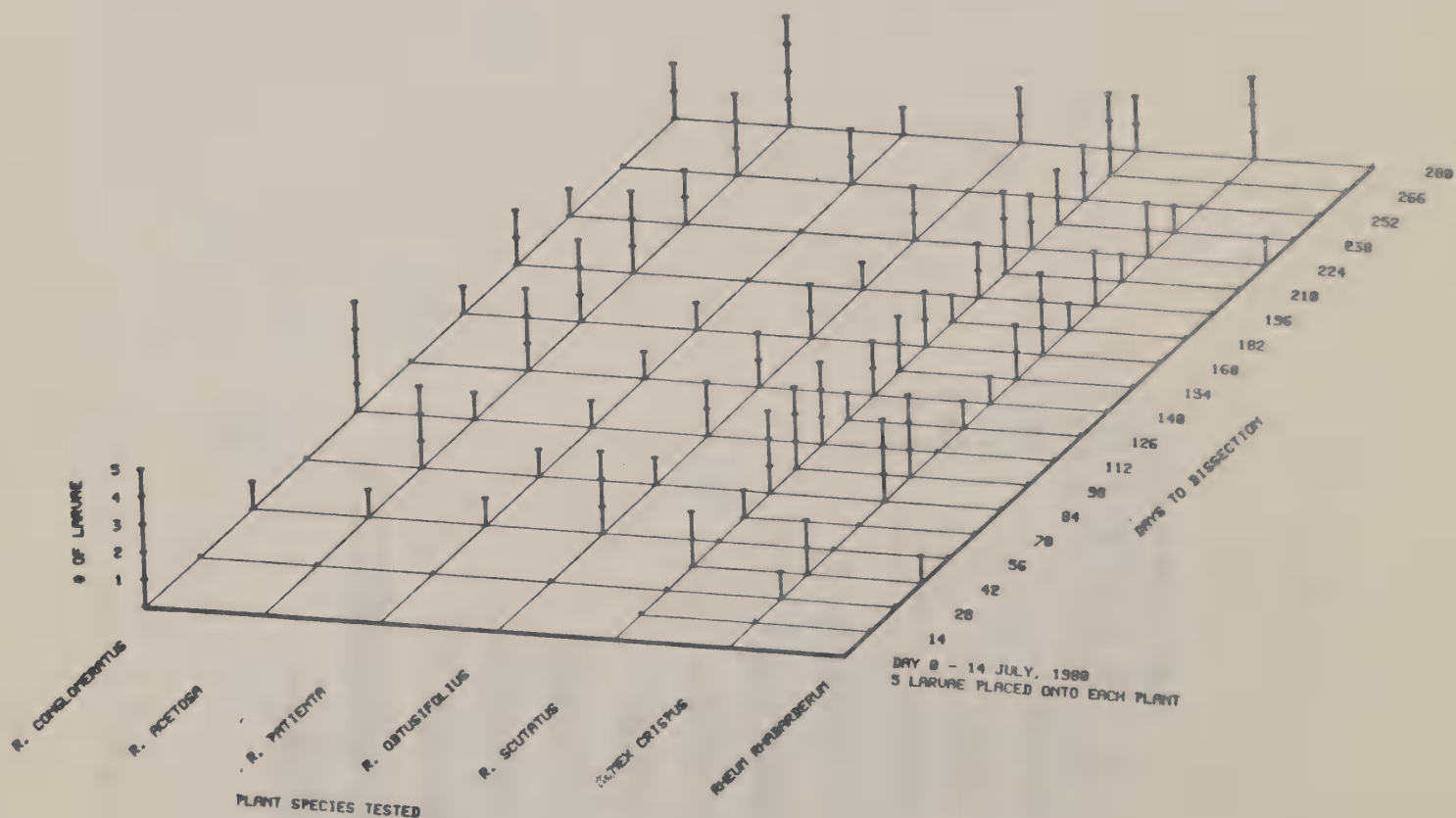


Fig. 4. Results of tests in which 5, 1st instar larvae of *Pyropteron chrysidiforme* were placed on seven species of plants. Vertical lines show the number of larvae dissected from the plants at the time shown on the right axis (Days to dissection).

COMPUTER 1977 - 1980

S. Rosenthal, N. Hostettler, N. Spencer

Statistics

The Basic Language statistical package originally purchased from Olivetti was based on the floppy disk system. Each statistical package had its own floppy disk, and when put onto the large fixed disk, interlinking of stat routines was impossible. Some programs had the same name making it difficult to run a particular statistical program. To eliminate these problems, a standard system was set up, using a single method to write a data file (input and output) to enable an interlinking of the various programs and procedures. Data is now entered once and can be used for most stat programs.

Plotting stat programs had been practically rewritten from scratch. Processed data can now be plotted with minimal effort on the external plotter with the X-Y axes drawn and labeled as decided by the operator.

Insect-data bank.

The *Rumex* insect collection was used as a pilot project for the lab's insect data bank. At present, 1100 records from the *Rumex* collection (1977-1980) are stored in this data bank. A total of 36 Programs and 30 Data file programs were written to enter, add, modify, check and retrieve collection data. This package is debugged and simplified so that other laboratory projects can now be stored in the computer.

Other uses.

Various programs, mainly involving the plotter were written for the laboratory's need:

- Information (*Rumex* survey) (1980)
- Climatological data.
- Information extraction from insect data bank to label herbarium sheets.
- Insect labels written on plotter
- General labeling/lines etc. (see cover of 1980 Annual Report; also see tables and figures in the 1980 Report).

TRAINING IN THE UNITED STATES

P. Pecora

In order to improve my background concerning the biological control of weeds, I spent five months (August - December, 1980) at the Albany Laboratory on a scientific scholarship granted by the C.N.R. (Italian National Research Council). During my stay at the Albany Laboratory, I conducted the following program of work.

Euphorbia project.

a. First writing of the manuscript "Biology and Host Specificity of *Oncochila simplex* (Hemiptera: Tingidae) as a Biological Control Agent of Leafy Spurge". The paper "The Lacebug *Oncochila simplex*, a Candidate for the Biological Control of Leafy Spurge" was presented at the North Central Weed Control Conference, Omaha (Nebraska), Dec. 9 - 11, 1980.

b. Trip to Oregon to release *Oberea erythrocephala* on leafy spurge. Trip made along with P. Dunn and J. Johnson.

c. Assisted with the manipulation of *O. erythrocephala* in quarantine.

Centaurea diffusa project.

a. Trip to Northern California to release *Sphenoptera jugoslavica* and *Urophora affinis*. Assisted with the manipulation of these insects in quarantine.

Carduus project.

a. Trip to Northern California to visit an infested area of *Carduus*, localized near Mount Shasta, where *Rhinocyllus conicus* was released in 1976.

b. Assisted with the manipulation of *Trichosirocalus horridus* and *Ceutorhynchus trimaculatus* in quarantine.

Convolvulus project.

a. Manipulation of *Galeruca rufa* in quarantine, conducted research to attempt to eliminate *Nosema* from *Galeruca* eggs.

b. Audit courses at the U.C. on "Insect Classification" and "Biological Control" (Fall quarter). Evening English course at the Albany Adult School.

Viewed research and quarantine facilities at Stoneville, Mississippi, Gainesville, Florida, and Beltsville, Maryland.

TRAINING IN THE UNITED STATES

N. Hostettler

I was offered a 5 months opportunity to do practical academic work in the U.S. if the travel costs were not chargeable to the Government. Thus, for this training period I paid my expenses and my salary was continued through UCB.

In January I visited various institutions. During the period February through May, I worked at the Biological Control of Weeds Laboratory, Albany, Calif. and attended classes at the University of California, Berkeley.

Institutions visited as inservice training.

Insect Identification and Beneficial Insect Introduction Institute, Beltsville, Maryland - sponsorship Dr. L. Knutson.

Plant Disease Research Laboratory, Frederick, Maryland - sponsorship Dr. R. Emge.

Biological Control Laboratory, Gainesville, Florida - sponsorship Dr. G. Buckingham.

Southern Weed Science Laboratory, Stoneville, Mississippi - sponsorship Dr. P. Quimby.

Grassland, Soil and Water Research Laboratory, Temple, Texas - sponsorship Dr. C. DeLoach.

Work conducted at USDA Lab in Albany.

To evaluate the *Rumex* problem in the US, a survey package was "compiled" and sent to weed specialists in each State. The package contained questions pertaining to the distribution-infestation, average infestation of crops and grassland and other habitats infested by *Rumex crispus*, *Rumex obtusifolius*, and *R. conglomeratus*. A second questionnaire was sent to the crop reporting service in each State to evaluate the importance of cultivated Polygonaceae: *Fagopyrum esculentum* Monch and various *Rheum* species (rhubarb).

Courses work, UC-Berkeley, Extension.

General Entomology, attended
Field Entomology, attended
Insect Behaviour, audited
Biological Field Photography, given by A. Blaker (short-course)

Travel within the United States.

Trip to Oregon and northern California with G. Johnson and A. Mayfields. Collection of *Phrydiuchus tau* Werner (Col. Curc) to control impact, infestation level and distribution on *Sativa aethiopis* L. (Labiateae), mediterranean sage.

Insects shipments from Rome Laboratory

| Plant - Insect | Location | No. Stage Date | Shipping Method | Condition | Receiving Location |
|--|-------------------------|--------------------------|-----------------|---------------------|----------------------------|
| <i>Centaurea solstitialis</i> <i>Urophora sirunaseva</i> | Bari, Italy | 1000 L & P Aug. 79 | APO | | Albany, Ca. (Maddox) |
| <i>Centaurea diffusa</i> <i>Spehnoptera jugoslavica</i> | Prespa Lake Greece | 184 A June 80 | Airfreight | good | Albany, Ca. (Maddox) |
| " | Prespa Lake Greece | 54 A June 80 | Airfreight | 22 alive 32 dead | Albany, Ca. (Maddox) |
| " | Prespa Lake Greece | 15 A June 80 | Airfreight | all dead | Albany, Ca. (Maddox) |
| Plant Pathogens | Bulgaria Greece | May-June 80 | Airmail | excellent | Beltsville, Md. (Emge) |
| " | Bulgaria Greece | May-June 80 | Airmail | | Switzerland (Defago) |
| <i>Euphorbia cyparissias</i> <i>Oberea erythrocephala</i> | Piacenza, Pisa Italy | 152 A July 80 | Airfreight | good | Albany, Ca. (Dunn) |
| <i>Convolvulus arvensis</i> <i>Galeruca rufa</i> | Rome Italy | 256 A Summer 1980 | Airfreight | good | Albany, Ca. (Rosenthal) |

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| <i>Euphorbia esula</i> <i>Lobesia</i> | Venezia Italy | 107 L & P Sept. 1980 | Airfreight | good | Switzerland (Schroder) |
| <i>Carduus</i> <i>T. horridus</i> <i>C. trimaculatus</i> | Italy | 314 <i>T. h.</i> 339 <i>C. t.</i> Nov. 1980 | Airfreight | | Albany, Ca. (Dunn) |
| <i>T. horridus</i> | Sila Italy | 25 A Nov. 1980 | Airfreight | | Albany, Ca. (Dunn) |

TRAVEL 1980

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| Jan 1 - June 3 | Hostettler to the US - Work study at the USDA-SEA-AR Laboratory, Albany, Ca. |
| February 18 - 21 | Pecora to Siena and Florence to take pictures of <i>Eteobalea</i> sp. with the scanning electron microscope. |
| March 17 - 19 | Pecora to Florence to attend the meeting "Stato attuale delle malerbe nei prati e nei pascoli in Italia". |
| March 31 - April 3 | Boldt to Bari and Sila to collect insects on <i>Lythrum</i> sp. |
| April 4 - 15 | Rizza to Calabria to collect <i>Linaria dalmatica</i> and <i>Trichosirocalus horridus</i> . |
| May 12 - 15 | Pecora and Rizza to Pisa and Piacenza to collect <i>Oncochila simplex</i> . |
| May 19 - 20 | Boldt to Paestum (Naples) to collect <i>Lythrum</i> sp. |
| May 24 - June 21 | Campobasso and Pecora to Yugoslavia, Bulgaria and Greece to collect <i>Eteobalea</i> spp. <i>Sphenoptera yugoslavica</i> , <i>Pterolonche inspersa</i> , and <i>Symira dentinosa</i> . |
| June 15 - 18 | Rizza to Pisa and Piacenza to collect <i>Oncochila simplex</i> and <i>Neoplinthus tigratus</i> . |
| June 30 - July 2 | Boldt to Piacenza to collect <i>Oberea erythrocephala</i> . |
| July 14 - 17 | Campobasso and Laregina to Pisa and Piacenza to collect <i>Oberea erythrocephala</i> . |
| July 15 - August 1 | Spencer to Australia to attend the V International Symposium on Biological Control of Weeds. |
| July 18 - August 6 | Rizza and Hostettler to Austria, Czechoslovakia, Poland, Germany and Switzerland to collect insects and pathogens on various <i>Euphorbia</i> sp. and <i>Rumex</i> sp. |
| August 1 - December 21 | Pecora work study in the US at Albany, California, USDA-SEA-WR, to improve background on biocontrol of weeds. |
| August 3 - 9 | Boldt to Kyoto, Japan, to attend the International Entomological Congress. |
| September 2 - 9 | Hostettler to Paris, to collect insects and pathogens on <i>Rumex</i> spp. |
| September 9 - 16 | Boldt and Laregina to North Italy to collect and survey <i>Lythrum</i> sp. |

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| September 24 - 27 | Boldt to South Italy to collect insects on <i>Lythrum</i> sp. |
| September 30 - October 2 | Hostettler to Abruzzo to collect <i>Pyropteron chrysidiforme</i> . |
| September 30 - October 7 | Boldt and Laregina to Sardegna (Italy) to survey and collect <i>Lythrum</i> sp. |
| October 8 - 13 | Campobasso and Rizza to Pisa and Piacenza to collect <i>Neoplinthus tigratus</i> and <i>Oncochila simplex</i> . |
| October 13 - 26 | Hostettler to Switzerland, to work on plant pathogens at the Federal Institute of Technology, and to France to collect <i>Urophora cardui</i> . |
| October 15 - 24 | Boldt and Laregina to Sicily (Italy) to survey and collect <i>Lythrum</i> sp. |
| October 29 - November 3 | Spencer to Greece to confere with the Greek Ministry of Agriculture about the organization of a greek substation. |
| November 16 - December 1 | Sobhian to Switzerland and Austria to visit museums and confere with specialists for <i>Centaurea solstitialis</i> project. |
| November 18 - 20 | Boldt to Florence to confere with Prof. Steinberg. |
| November 24 - 27 | Campobasso to Sila (Calabria) to collect <i>Trichosirocalus horridus</i> on <i>Carduus</i> sp. |
| December 15 - 17 | Campobasso to Piacenza to collect <i>Oncochila simplex</i> . |

PUBLICATIONS

- Rizza, A., and P. Pecora. 1980. Biology and host specificity of *Chrysomela rossia* a candidate for the biological control of dalmatian toadflax, *Linaria dalmatica*. Ann. Ent. Soc. Am. 73 (1): 95-99.
- Rizza, A., G. Buckingham, and P. Pecora. 1980. Host specificity studies on *Ceutorhynchus maculaalba*, a potential candidate for the biological control of opium poppy. Environ. Ento. 9: 681-688.
- Pecora, P. 1980. Considerazioni sul controllo biologico delle malerbe e relative prospettive d'impiego nei prati e nei pascoli in Italia.
- Boldt, P.E., and J.J. Drea. 1980. Packaging and shipping beneficial insects for biological control. FAO Plant Prot. Bul. 28 (2): 64-71.
- Rizza, A., and N. R. Spencer. 1980. Field tests with the musk thistle insects, *Trichosirocalus* (*Ceuthorhynchidius*) *horridus* and *Ceutorhynchus trimaculatus* on artichoke two weevils candidates for the biocontrol of *Carduus* genus. In Press Environ. Ento. 9.
- Boldt, P.E., G. Campobasso, and E. Colonnelli. 1980. Palearctic distribution and host plants of *Ceutorhynchus trimaculatus* and *Ceuthorhynchidius horridus*. Accepted for publ. Ann. Entomol. Soc. Am.

PAPERS PRESENTED

- Spencer, N.R., S. Geist Rosenthal, and N. Hostettler. 1980. A computer assisted method for the storage, retrieval and analysis of biological field data. For publication in the Proceedings of the V Int. Symp. on Bio.Contr. of Weeds. Brisbane, Australia.
- Spencer, N.R. 1980. Exploration for biotic agents for the control of *Rumex crispus*. For publication in the Proceedings of the V Int. Symp. on Bio.Contr. of Weeds. Brisbane, Australia.
- Brunetti, N., N.R. Spencer, M. Bonetti, P. Marzetti, F. Pacciaroni and U. Franconi. 1980. Use of the waterhyacinth, (*Eichhornia crassipes* (Mat.) Solms) for sewage and wastewater treatment in Italy. Proc. Journee Europeennes de Bio-Energie. France.
- Pecora, P., and A. Rizza. 1980. The lacebug, *Oncochila simplex*, a candidate for the biological control of leafy spurge. 1980 North Central Weed Control Conference. Omaha, Nebraska.

VISITORS 1980

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| January 10 | Dr. D. A. Johnson, Range Plant Physiologist, USDA-SEA-AR, Utah State University, Logan, UT. |
| February 26-27 | Dr. A. J. Wapshere, CSIRO, Biological Control Unit, Montpellier, France. |
| May 20 | J. D. Paszke, Dept. of Entomology, Purdue University, West Lafayette, IN. |
| September 18 | Dr. J. J. Drea, Biological Control of Pests and Insect Taxonomy, Beltsville, MD. |
| October 6 | Mr. Ronald E. Stewart, Forest Service, Washington, D.C. |
| November 5 | Ms. Anna Pinkney, State Dept. Inspector, SIG. Washington, D.C. |

Reports sent to:

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Laboratory, Columbia, MO.
Dr. H. Cordo, Hurlingham, Argentina
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P. Quimby, Stoneville, MS
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C.H. Kingsolver, Frederick, MD.
L. Matthews, FAO, Rome, Italy
L.A. Andres, Albany, CA.
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